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Passive Smoking Among Children with Chronic Respiratory Disease

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ABSTRACT

The purpose of this study was to determine the prevalence and source of passive smoke exposure among children with chronic respiratory diseases and compare these to both a well child and nonrespiratory chronic illness child population. Rates and source of passive smoke exposure were compared among four child groups: asthma, cystic fibrosis, rheumatoid arthritis, and well children using a questionnaire mailed to the parents of the selected children. Twenty percent of respondents reported current smoking with a significantly higher rate among the cystic fibrosis and rheumatoid arthritis groups. One-third of all children surveyed were exposed to passive smoke at home and/or day care on a daily basis. Over 80% of the asthma and cystic fibrosis respondents reported a change in smoking behavior (i.e., smoking outside the home or smoking fewer cigarettes) after the diagnosis of their child's illness as compared with only 40% of the nonrespiratory groups. Health care providers need to inquire about potential sources of passive smoke exposure in their patients, particularly children with chronic respiratory disease.

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INTRODUCTION

In 1986 the Surgeon General and the National Academy of Sciences reported that passive smoking by nonsmokers, including children, can cause significant morbidity (1,2). Numerous studies have documented the adverse effects of parental cigarette smoking on children including; increased occurrence of respiratory illness (3–8), decreased pulmonary function (9), and increased physician visits (10), hospitalization rates (11,12), and emergency room (ER) visits (13). A dose-dependent relationship between the estimate of passive smoke exposure and overall severity of disease based on hospital admissions, growth, nutrition, and peak expiratory flow rates, has been demonstrated in children with cystic fibrosis (14).

Approximately 29% of adults in the United States currently smoke cigarettes (15) and 70% of children live in homes where there is at least one adult smoker (16). Tobacco smoke is ubiquitous in public areas and exposure to environmental tobacco smoke is unavoidable in these settings. However, there are no studies which quantitate the daily exposure to passive smoke among children with chronic respiratory illnesses, including asthma (AS) and cystic fibrosis (CF).

The primary objective of the present study was to determine the prevalence and source of passive smoke exposure among children with chronic respiratory diseases including AS and CF and to compare these to both a well child and nonrespiratory chronic illness child population. Passive smoke exposure was defined as daily involuntary inhalation of cigarette smoke by a child either in their home or in a day care/child care setting. We hypothesized that children with chronic respiratory diseases would be less exposed to passive smoke than the well child and nonrespiratory illness groups due to parental awareness of the adverse respiratory effects of passive smoke exposure.

METHODS

Study Population and Procedures

The study was cross-sectional in design and was conducted by a mailed parent questionnaire (available upon request) to four groups: asthma (AS), cystic fibrosis (CF), rheumatoid arthritis (RA), and well children (WELL). The CF and RA patients, primarily caucasian and with private health insurance, were recruited from hospital-based outpatient specialty clinics in order to obtain an adequate sample size. Most AS and WELL patients attending hospital-based clinics were from families of low socioeconomic status (SES). Therefore, in order to select a group of patients of comparable SES, the AS and WELL groups were recruited from private pediatric practices in the same metropolitan area. Questionnaires were mailed to each group with the following distribution: AS 175, CF 154, RA 134, and WELL 171 for a total mailing of 634 questionnaires. Approval for the study was obtained from the Joint Committee on Clinical Investigation of the Johns Hopkins Medical Institutions.

Parent questionnaires were mailed between June and October 1989. Information was obtained on sociodemographic characteristics, household members' smoking habits, childrens' passive smoke exposure at day care and afterschool programs, and change in smoking behavior or smoking cessation attempts of respondent (RES) smokers.

A SES rating was assigned to each family based on the respondent's or head of household's income, educational level, and occupation. Two levels of SES were defined. Low SES was defined as (a) gross income less than $30,000, (b) less than high school education, or (c) semiskilled or unskilled labor occupation or receipt of public assistance. High SES included all other respondents. The income level criterion of $30,000 was selected based on the income distribution of the

sample. Seventy-three percent of RES reported an income greater than $30,000 which was the upper level used on the questionnaire. Because of the skewed distribution of income level, the classification of low SES is relative to other subjects in this sample.

All RES were asked "Have you every smoked?" as well as ascertainment of smoking habits of other family members, relatives, and visitors, including number cigarettes smoked and smoking location in household. Respondents who reported current smoking were asked "Have you changed your smoking habits since your child was diagnosed with his/her disease or since having children?," and "Have you ever tried to stop smoking?"

To increase the response rate, a fast food coupon was enclosed with each survey and a second mailing was conducted within two months of the initial mailing. Telephone follow-up of nonrespondent CF families was conducted at the end of three months to compare smoking prevalence of nonrespondents and RES. Only the CF group was selected for follow up due to resource constraints.

Statistical Analyses

Mean baseline RES characteristics, parental smoking habits and passive smoke exposure among child groups were compared using Chi-square analysis, Student's t-test, and analysis of variance (ANOVA). Chi-square analysis was used to compare SES levels among the groups. Multivariate logit (logarithm of the odds) analyses were performed to estimate the likelihood of passive smoke exposure among the four groups. Using the multivariate logistic regression technique, the combined effects of age, gender, SES, and child group can be examined simultaneously for their association with passive smoke exposure in the child. After several logistic models were tested, a final set of parameters was selected based on significant bivariate association with passive smoke exposure and clinical significance. The final model tested to predict passive smoke exposure included the independent variables: RES gender, education, income and child group and age. All analyses were carried out using the SAS computer package (17).

RESULTS

Population Characteristics

The response rate varied by child group; AS 102/175 (58%), CF 103/154 (66.9%), RA 50/134 (37.3%), and WELL 105/171 (61%). The overall response rate was 360/634 (56.8%). Respondents tended to be white (94.3%), female (63.7%), and married (86.9%) with a mean age of 38.4 years (Table 1). The mean age of the index child was 9.3 years. Over three-quarters of RES (78.9%) reported a high school education and 51.6% reported a college education. Median household income was over $30,000. Respondent age, gender, education level, marital status, income, and occupation differed significantly by child group (Table 1). The CF and RA groups had significantly more low SES families as compared to the AS and WELL groups (CF 48.4%, RA 48%, AS 33.3%, WELL 24.8%, X^2 = 15.77, p = .001) (Table 1).

Smoking Characteristics

Current smoking (within the last month) was reported by 20.3% (73/360) of RES (Table 2) with a significant difference among the groups (p = .008). Among all RES, there was no difference in smoking frequency by gender (χ^2 = 5.33, p = .149). The CF and RA groups reported the highest current smoking rates (29.1% and 28%, respectively). Current smokers reported smoking a mean of 16.7 cigarettes per day and smoking for a mean of 16.6 years (Table 3). There were no significant differences among the groups for these parameters. The percentage of nonsmokers (never smoked) (44.4%) and ex-smokers (35.3%) did not differ significantly by group (nonsmokers, χ^2 = 5.2, p = .157; ex-smokers χ^2 = 1.9, p = .603) (Table 2). Previous attempts to stop smoking were reported by 79.5% (58/73) of the current smokers (Table 3) and did not differ significantly among the groups (χ^2 = 5.1, p = .167). Most quitters

Table 1. Baseline Variables for Total Respondent Sample and for Each Child Group

	AS	CF	RA	WELL	TOTAL	p VALUE
Sample size	102	103	50	105	360	
Age (years) Mean ± SD	39.7 (±12.3)	37.9 (±11.6)	41.5 (±14.4)	36.1 (±6.2)	38.4 (±11.1)	F = 3.36 p = .019
Females (%)	72.6	65.1	76.0	47.6	63.7	X^2 = 18.4 p < .001
White (%)	93.9	96.0	89.8	95.2	94.3	X^2 = 5.7 p = .463
Married (%)	92.2	75.7	86.0	93.3	86.9	X^2 = 16.1 p = .001
High school education (%)	89.2	67.9	60.0	88.6	78.9	X^2 = 52.9 p < .001
Income > $30,000 (%)	77.5	63.1	66.0	80.9	72.8	X^2 = 13.9 p = .03
Professional occupation (%)	48.5	44.6	22.6	59.8	48.4	X^2 = 18.6 p = .03
SES (low) (%) (high) (%)	33.3 66.7	48.5 51.5	48.0 52.0	24.8 75.2	37.2 62.8	X^2 = 15.8 p = .001

Table 2. Smoking Variables for Total Respondent Sample and for Each Child Group

	AS	CF	RA	WELL	TOTAL	p VALUE
Sample size	102	103	50	105	360	
Nonsmokers (Never smoked)	47 (46.1%)	37 (35.9%)	22 (44.0%)	54 (51.4%)	160 (44.4%)	X^2 = 5.2 p = .157
Ex-smokers	40 (39.2%)	36 (34.9%)	14 (28.0%)	37 (35.2%)	127 (35.3%)	X^2 = 1.9 p = .603
Current smokers	15 (14.7%)	30 (29.1%)	14 (28%)	14 (13.3%)	73 (20.3%)	X^2 = 11.9 p = .008

Table 3. Current Smokers: Smoking Variables and Quit Attempts by Child Group

	AS	CF	RA	WELL	TOTAL	p VALUE
Proportion of current smokers	15/102	30/103	14/50	14/105	73/360	X^2 = 11.9 p = .007
Number of cigarettes/day[a]	17.5 ± 10.8	14.6 ± 9.5	18.3 ± 9.1	18.9 ± 17.4	16.7 ± 11.5	F = .59 p = .63
Number of years smoked[a]	16.3 ± 6.6	16.1 ± 7.5	17.1 ± 9.9	17.0 ± 4.2	16.6 ± 7.2	F = .20 P = .89
Number of respondents who changed[b] smoking behavior after diagnosis or after child born (excluding quit attempts)	12/15 (80%)	25/30 (83.3%)	4/14 (28.6%)	7/14 (50%)	48/73 (66%)	X^2 = 12.4 p = .006
Quit attempts	11/15 (73%)	21/30 (70%)	13/14 (92.9%)	13/14 (92.9%)	58/73 79.5%)	X^2 = 5.1 p = .167

[a]Mean ± SD.

[b]Changes included: smoke outside household, decrease number of cigarettes, smoke only at work, or smoke only at night.

(76%) reported using no structured smoking cessation program, but rather stopped "cold turkey" on their own. Furthermore, only a third (34%) of quitters reported stopping for longer than one year.

Prevalence of Passive Smoke Exposure by Study Group

Thirty percent of all RES reported one or more smokers in the household on a regular basis (Table 4); 12% of RES had two or more smokers per household. Households with one or more smokers were reported significantly more often by the CF and RA respondents ($\chi^2 = 9.24$, $p = .03$) (Table 4). Exposure to smoke in a day care setting was reported by 18.4% of all families; there was no significant difference by group. Daily passive smoke exposure, either in the household or day care/after care, was reported by a third of all RES (Table 4) and differed significantly by child group ($\chi^2 = 12.02$, $p = .007$). Both the CF and RA groups reported higher daily passive smoke exposure rates as compared with the AS and WELL groups. Passive smoke exposure also differed by SES group. Among the high SES respondents, there were no significant differences by group between the daily passive exposure rates ($\chi^2 = 4.43$, $p = .22$). However, among the low SES respondents, the CF and RA groups reported significantly higher rates of daily passive smoke exposure as compared with the AS and WELL groups ($\chi^2 = 9.68$, $p = .02$).

Factors associated with passive smoke exposure examined by logistic regression are shown in Table 5. In the CF and RA groups, less education independently predicted passive smoke exposure. Child's age was also associated with passive smoke exposure, i.e., younger age was associated with more passive smoke exposure. Respondent's gender and income did not predict passive smoke exposure. There were no significant correlations ($r < .32$) between any of the selected variables in the final logistic model. All interaction terms were statistically nonsignificant in the tested logistic models.

Change in Smoking Behavior

Sixty-six percent (48/73) of current smokers reported a change in smoking behavior following a diagnosis of their child's disease or the birth of their index child (Table 3). Thirty percent (22/73) of current smokers reported no change in smoking behavior following the diagnosis of their child's disease. Smoking behavior information was not available for three smokers. Parents of children with AS and CF reported a significantly higher rate of

Table 4. Passive Smoke Exposure: Number and Type of Exposures by Child Group

	AS	CF	RA	WELL	TOTAL	p VALUE
Sample size	102	103	50	105	360	
Type of exposure						
1 or more current household smokers	28/102 (27.5%)	40/101 (39.6%)	17/50 (34%)	22/105 (20.9%)	107/358 (29.9%)	$X^2 = 9.24$ $p = .03$
Exposed to smoker in daycare	3/21 (14.3%)	7/23 (30.4%)	1/9 (11.1%)	5/34 (14.7%)	16/87 (18.4%)	$X^2 = 10.08$ $p = .34$
Daily passive[a] exposure (*All* SES groups)	28/102 (27.5%)	46/103 (44.7%)	18/50 (36%)	25/105 (23.8%)	117/360 (32.5%)	$X^2 = 12.02$ $p = .007$
Daily passive[a] exposure (High SES groups)	16/68 (23.5%)	20/53 (37.7%)	5/26 (19.2%)	20/79 (25.3%)	61/226 (26.9%)	$X^2 = 4.43$ $p = .22$
Daily passive[a] exposure (Low SES groups)	12/34 (35.3%)	26/50 (52%)	13/24 (54.2%)	5/26 (19.2%)	56/134 (41.8%)	$X^2 = 9.68$ $p = .02$

[a]Household and/or day care smoke exposure.

Table 5. Logistic Regression Results of Sociodemographic Characteristics and Child Group on Passive Smoke Exposure

	ESTIMATE BETA	STANDARD ERROR OF BETA	ODDS RATIO	95% CI
Intercept	4.355	1.14	–	–
Gender (RES)	−.230	.265	.78	.46, 1.31
Education (RES)	−.585	.154	.56	.41, .75[b]
Income (RES)	−.278	.179	.76	.53, 1.07
Child's age	−.051	.025	.95	.90, .99[a]
Child group	−.246	.120	.78	.62, .99[a]

Model $X^2 = 34.45$ with 5 df, $p < .0001$

[a] $p < .05$.
[b] $p < .001$.

change in their smoking habits (i.e., smoke outside the household or smoking fewer cigarettes) as compared with the RA and WELL groups ($\chi^2 = 12.4$, $p = .006$) (Table 3).

The most frequently reported modifications in smoking behavior were a combination of smoking in another room or outside the home away from the child and smoking fewer cigarettes (41.3%), smoking outside the household only (28.3%) and smoking fewer cigarettes only (13%). Other changes such as smoking only at night, smoking only at work, smoking in another room away from the child, or using an air purifier in the home were reported by 17.4% of smokers who changed behavior.

Table 6. Type of Change in Smoking Behavior Reported by Current Smokers (n = 46)

TYPE OF CHANGE	NUMBER	PERCENT
Smoke outside of household	13	28.3
Decrease the number of cigarettes smoked	6	13.0
Smoke in another room away from child	5	10.9
Smoke only at work	1	2.2
Smoke only at night after children in bed	1	2.2
Smoke in house, but use air purifier	1	2.2
Combination of smoking in another room or outside the home and decreasing number of cigarettes	19	41.2
	46	100%

Smoking Patterns of Nonresponders

Of the 51 CF nonrespondents, 39 (76.5%) were contacted by telephone and responded to a brief smoking survey ascertaining only parental and household smoking proportions. Parental smoking was reported by 39.2% of the nonrespondents compared to 29% of the CF respondents. Household smoking was reported by 63% of CF nonrespondents as compared with 40% of the CF respondents ($\chi^2 = 6.88$, $p = .01$).

DISCUSSION

The proportion of RES in the study who reported current smoking (20.3%) is lower than both the national (29%) and Maryland (23.9%) rates of current smokers (18). This lower rate may reflect reluctance by parents of children with a chronic disease to disclose smoking behavior. The prevalence of smoking in CF nonrespondents (39.2%) was higher than in RES (29.1%) which would increase the actual rate of passive smoke exposure in the CF and perhaps the AS groups. The higher rate of smoking in the CF nonrespondents may reflect self-selection bias. However, the household smoking rate of 45.7% (65/142) among combined CF respondents and nonrespondents is comparable to the 56% household smoker rate previously reported in CF families (14). In our CF sample, smokers were less likely to respond to the questionnaire. However, during a telephone interview

they did reveal their smoking behavior yielding a higher rate of current smokers. This suggests that underreporting of smoking is likely the case in our data, tending to underestimate the true risk of passive smoke exposure in patients with a chronic respiratory illness. One limitation of our data is lack of follow up of other nonrespondents. This would determine if parents of children with a respiratory disease are less likely to respond to a smoking questionnaire as compared to parents of children diagnosed with a nonrespiratory disease.

Differences in current smoking rates varied among the disease groups with the CF and RA groups reporting a significantly higher frequency of passive smoke exposure in their homes. Smoking characteristics, including number of cigarettes smoked per day and number of years smoked as reported by current smokers, did not differ by disease group.

Socioeconomic differences most likely explain the higher rates of smoke exposure among the patients in the CF and RA groups. There were significantly higher numbers of RES in the CF and RA groups who had low SES (Table 1). When the SES levels were combined, daily passive smoke exposure was significantly higher in the CF and RA groups (Table 4). However, these differences disappeared when the high SES respondents were examined separately. Among low SES respondents, daily passive smoke exposure remained higher in the CF and RA groups. Lower education was the only SES factor which independently predicted passive smoke exposure in the sample controlling for RES age, gender, occupation, income, and child's age (odds ratio, .55; 95% CI, .41, .75) (Table 5). This is consistent with National Health Interview survey data in which the prevalence of smoking was higher among lower SES persons, and smoking prevalence decreased with increased years of education and household income (15). Even after controlling for the unequal distribution of income in the four groups, lower education was the strongest predictor of parental smoking. Racial differences in smoking patterns were not apparent due to the homogeneity of our sample.

Self-reported cigarette consumption is generally reliable (19). Previous reports of a strong dose-dependent relation between self-reported tobacco smoke exposure and salivary and urinary continine levels support the reliability of self-reported cigarette consumption (20). A comparison of adjusted consumption data from cigarette excise taxes (U.S. Department of Agriculture) and self-reported cigarette consumption as reported from National Health Interview Surveys (NHIS) was consistent, supporting the reliability of self-reported smoking data (19). Expected bias in our data would be the underrepresentation of smokers, thereby reducing the true proportion of smokers in each group. Therefore, our data probably reflect the minimal level of smoking in this population.

Other sources of passive smoke exposure including day care and after school care are consistent with recent reports of passive smoke exposure in neonates attending day care (21). The finding that 18.4% of all children and 30.4% of CF patients in our sample attended a day care facility in which they were exposed to a smoker warrants increased public awareness and action. Regulation of worksite smoking policies should include day care and after school personnel in order to reduce a significant source of passive smoke exposure in children. At a minimum, parents must request that a no smoking policy be implemented in day care settings.

It is encouraging that more than 80% (37/45) of the AS and CF respondents reported a change in their smoking behavior after the diagnosis of their child's illness as compared with only 39.3% (11/28) of the combined RA and WELL respondents (Table 3). Eighty percent of all current smokers reported at least one unsuccessful attempt to quit (Table 3).

Based on the evidence that passive smoke exposure causes increased morbidity and decreased pulmonary function in patients with AS (22-24) and CF (14), it is disturbing that 44.7% of CF patients and 27.5% of AS patients in our sample reported daily passive smoke exposure and that 30.1% (22/73) of the children in our sample reside in a household with parents who smoke and report no change in their smoking behavior. Health care providers need to stress the importance of ascertaining the smoking status of day care personnel as well as other household contacts and

to encourage attempts to quit by household members who smoke (25).

SUMMARY AND CONCLUSIONS

In conclusion, our data indicate that a third of all children surveyed (chronically ill and well) are exposed to passive smoke on a daily basis including home and day care settings. Health care providers should inquire about potential sources of passive smoke exposure in their patients, particularly children with chronic respiratory disease, and counsel them accordingly.

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